

## CLAIMS

1. A system for a chemically bonded material, comprising

an aqueous hydration liquid;

a powdered material comprising a first binder phase (c), which powdered material has the capacity following saturation with the liquid reacting with said first binder phase to hydrate to a chemically bonded ceramic material;

a second, non-ceramic binder phase having a different initiation time for setting and/or a different setting rate than the initiation time for hydration and the hydration rate, respectively, of said first binder phase,

characterised in that the system further comprises

a reactive glass; and

a second portion of aqueous hydration liquid ( $w_{GIC}$ ),

wherein

$$w = w_c + w_{GIC}$$

$$(w_c/c) + (\text{second binder phase})/(\text{reactive glass}) + w_{GIC}/(\text{reactive glass})$$

with  $0.2 < w_c/c < 0.45$ ,  $0 < (\text{second binder phase})/(\text{reactive glass}) < 0.21$  and  $0.2 < w_{GIC}/(\text{reactive glass}) < 0.45$ .

and in that the system provides for an ionic interaction between the hydration reactions and setting reactions of the first binder phase (c) and the second binder phase, respectively.

2. A system according to claim 1, characterised in that it is adapted to enable an initial pH to be kept  $< 7$ , more preferably  $< 4$  and most preferably 1-3 to control properties related to different initiation time for setting and hardening of the part systems.

3. A system according to any one of claims 1-2, characterised in that the second binder phase comprises a polycarboxylic acid and/or a copolymer or a salt or an ester thereof providing a pH value in the system of  $< 7$ , preferably  $< 4$  for the first 20 minutes after mixing, preferably, a pH in the interval 1-4 for the first 10

minutes, and most preferably for the first 5 minutes.

4. A system according to any one of claims 1-2, characterised in that a base is comprised in the system, so as to achieve a change of the pH to a pH > 7, more preferably a pH > 10, after an initial period of time after mixing of the system of a few minutes up to approximately 5 minutes at pH < 7.

5. A system according to any one of claims 1-3, characterised in that an additional acid is comprised in the system, so as to keep the pH < 7 during a prolonged time of up to 30 minutes, preferably up to 20 minutes.

6. A system according to claim 4 or 5, characterised in that the system comprises a porous material, preferably a nano/meso-pore structure or a zeolite type structure, that is able to release said base or acid, respectively.

7. A system according to claim 4 or 5, characterised in that particles of said first binder phase are coated with a dissolution-reducing layer, preferably comprising a glyconate.

8. A system according to any one of the preceding claims, characterised in that it comprises inert filler particles composed of pre-hydrated chemically bonded ceramics, preferably of the same composition as said first binder phase.

9. A system according to any one of the preceding claims, characterised in that it comprises semihydrate of  $\text{CaSO}_4$  and/or a combination of phosphoric acid and zinc oxide-forming Zn-phosphate.

10. A system according to any one of the preceding claims, characterised in that the system yields an initial strength above 5 MPa measured by diametral tensile strength after 15 minutes.

11. A powdered material for dental or orthopaedic applications comprising a first binder phase essentially consisting of a cement system, which powdered material has the capacity following saturation with a hydration liquid reacting with said first binder phase to hydrate to a chemically bonded ceramic material, and

an additive of a second, non-ceramic binder phase having a different initiation time for setting and/or a different setting rate than the initiation time for hydration and the hydration rate, respectively, of said first binder phase, characterised in that the second binder phase comprises a polycarboxylic acid or a copolymer or a salt or an ester thereof having a molecular weight of 100–250,000, preferably 1000–100,000, in an amount of up to 30 % by weight, based on the powdered material including any dry additives.

12. A powdered material for dental applications of claim 11, characterised in that the polycarboxylic acid or a copolymer or a salt or an ester thereof, is present in an amount of 1-20 %, and preferably 3-15 % by weight, based on the powdered material including any dry additives.

13. A powdered material for orthopaedic applications of claim 11, characterised in that the polycarboxylic acid or a copolymer or a salt or an ester thereof is present in an amount of 1-15 % and preferably 2-5 % by weight, based on the powdered material including any dry additives.

14. A powdered material of any one of the claim 11-13, characterised in that the chemically bonded ceramic material is a material in the group that consists of aluminates, silicates, phosphates, sulphates and combinations thereof, preferably having cations in the group that consists of Ca, Sr and Ba, calcium aluminate cements being most preferred, in which case the first binder phase preferably has a composition between the phases  $3\text{CaO} \cdot \text{Al}_2\text{O}_3$  and  $\text{CaO} \cdot 2\text{Al}_2\text{O}_3$ , most preferably about  $12\text{CaO} \cdot 7\text{Al}_2\text{O}_3$ , optionally as glass phases.

15. A powdered material according to any one of the claim 11-14, characterised in that at least a part or most preferred all the reactive groups of said polycarboxylic acid or salt thereof bond to the chemically bonded ceramic material.

16. A powdered material according to any one of the claim 11-15, characterised in that said polycarboxylic acid or copolymer or salt or ester thereof is a substance in the group that consists of poly acrylic acid, poly(acrylic-co-maleic acid), poly(itaconic acid), tricarballic acid; copolymers, salts and esters thereof;

and combinations thereof.

17. A powdered material according to any one of any one of the claim 11-16, characterised in that it contains an inert phase additive, preferably including dental glass and preferably at a content of 3-30 weight-% more preferably 5-20 %.

18. A powdered material according to claim 17, characterised in that said inert phase additive has a particle size of 0.1-5  $\mu\text{m}$ , more preferably 0.2-2  $\mu\text{m}$ , and most preferably 0.3-0.7  $\mu\text{m}$ .

19. A powdered material according to claim 17 or 18, characterised in that said inert phase comprises low amounts of less stable phases or reactive phases including glasses, preferably below 10 % of the inert phase content, which less stable phases or reactive phases preferably comprise fluoride and/or phosphorus.

20. A powdered material according to any one of claims 11 to 19, characterised in that it has the form of granules, preferably of a size below 1 mm, more preferred below 0.5 mm and most preferred below 0.4 mm and having a granule compaction density above 35 %, preferably above 50 % most preferred above 60%.

21. An aqueous hydration liquid for a powdered material comprising a first binder phase essentially consisting of a cement system, which powdered material has the capacity following saturation with the hydration liquid reacting with said first binder phase to hydrate to a chemically bonded ceramic material, characterised in that said hydration liquid comprises an additive of a second, non-ceramic binder phase, which second binder phase has a different initiation time for setting and/or a different setting rate than the initiation time for hydration and the hydration rate, respectively, of said first binder phase, and in that the hydration liquid together with the powdered material provides for an ion interaction between the hydration reactions and setting reactions of the first binder phase and the second binder phase, respectively.

22. An aqueous hydration liquid according to claim 21, characterised in that said second binder phase comprises a polycarboxylic acid or a copolymer or a salt or an ester thereof.

5 23. An aqueous hydration liquid according to claim 22, characterised in that at least a part or most preferred all of the reactive groups of said polycarboxylic acid or salt thereof bond to the chemically bonded ceramic material.

10 24. An aqueous hydration liquid according to claim 22 or 23, characterised in that said polycarboxylic acid or copolymer or salt or ester thereof is a substance in the group that consists of poly acrylic acid, poly(acrylic-co-maleic acid), poly(itaconic acid), tricarballic acid; copolymers, salts and esters thereof; and combinations thereof.

15 25. An aqueous hydration liquid according to any one of claims 22-24, characterised in that said polycarboxylic acid or copolymer or salt or ester thereof has a molecular weight of 100-250,000, preferably 1000-100,000.

20 26. An aqueous hydration liquid according to any one of claims 21-25, characterised in that it has a pH of 1-7, preferably > 3, before the hydration and setting reactions.

25 27. A chemically bonded material, the binder phase of which essentially consists of an inorganic cement phase and which material is *in situ* formed on a substrate or in a cavity, characterised in that said material also comprises a reactive, soluble glass, an *in situ* formed phase of polyacrylate polymer or copolymer.